

PATENT APPLICATION

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**FLUSH PANEL SPACER AND METHOD AND
APPARATUS OF INSTALLING THE SAME**

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BACKGROUND OF THE INVENTION

1. Related Applications

5 This application is a continuation in part application of U.S. Patent No. 6,298,633 filed on February 3, 1999.

2. Field of the Invention

The present invention is directed to spacers for mounting fasteners in sandwich panels, a method of installing the spacers so that the spacers are flush with an upper
10 surface of the panels and can provide a liquid tight seal and a resultant improved panel assembly, such as a floor of an aircraft.

3. Description of Related Art

In the aerospace field a premium is placed upon light-weight but strong structural components. For example, a floor of an aircraft must be lightweight and strong and also
15 must accommodate the stresses imposed upon the bulkhead by the flexing of the wings during flight. The aircraft industry uses sandwich panels that are fastened to spars and bulkheads by a large number of fasteners that are secured to the panels by extending through corresponding spacers mounted in the panels. Frequently, the sandwich panels are formed of thin aluminum face plates with expandable aluminum foil strips to form a
20 core or laminated plastic resin upper and lower surface face sheets that sandwich a honeycomb interior structure of resin and paper. Both configurations provide excellent strength to weight or stiffness to weight relationships in comparison to solid metallic panels. Alternative face sheets or skins for sandwich panels can include steel, titanium,

magnesium, aluminum alloys, and alloy steels, while cores can also be formed of plastic foam, balsa wood, high temperature alloys, plastic syntactic and steel foil. Generally, the core is honeycomb and has hexagonal cells with walls perpendicular to the face sheets.

Composite panels are frequently used in aircraft with high-strength, high-modulus, fiber-reinforced, thermostat or thermoplastic resins. However, such fiber-reinforced composite panels do not necessarily respond well to localized concentrated loading forces. As can be appreciated, when a composite structure is used as a floor panel or wall panel in an aircraft, it is frequently necessary to fasten objects to the panels. Thus, a number of different fasteners and spacers have been developed to accommodate resin sandwich panels and to prevent a localized concentration of loading.

Some of the problems that have been recognized in the installation of a spacer are the necessary chemical compatibility of any fastener or spacer used in sandwich panels so that there is not any galvanic corrosion. This issue frequently arises when the sandwich panels contain carbon fiber, and if the fibers come in contact with a less noble metallic fastener, there can be corrosion, thus, magnesium, aluminum, aluminum alloys, and alloy steels are frequently not compatible with a graphite based structure.

Another problem that has occurred with mounting fasteners and spacers in a sandwich panel is that the panel does not have a significant transverse reinforcement. Thus, when a hole is drilled for mounting a spacer, the edge of the hole can be crushed, since there is relatively little resistance to a crushing force.

As can be appreciated, the application of a fastener or spacer to a sandwich panel can damage the panel in drilling holes in the panels in that surface ply splintering, surface ply delaminating, heat damage, and irregularities inside the hole can occur.